

In re Patent Application of:
RAYNOR ET AL.
Serial No. 10/677,850
Filing Date: OCTOBER 2, 2003

REMARKS

Applicants would like to thank the Examiner for the thorough examination of the present application. The independent claims have been amended to more clearly define the present invention over the cited prior art references. The claim amendments and arguments supporting patentability of the claims are provided below.

I. The Amended Claims

The present invention, as recited in amended independent Claim 39, for example, is directed to method of attaching a sensor and a housing to opposite sides of a mounting substrate. The sensor has a sensing face and comprises a sensing area and at least one signal output contact thereon. The mounting substrate has a circuitry face and at least one signal input contact thereon. The mounting substrate also has an opening therethrough. The method comprising positioning the sensing area over the opening so that the at least one signal output contact of the sensor contacts the at least one signal input contact of the mounting substrate.

The sensor is attached to the mounting substrate via at least one bump bond interposed between the at least one signal output contact of the sensor and the at least one signal input contact of the mounting substrate to pass signals therethrough. Independent Claim 39 has been amended to recite that the at least one bump bond is associated with a respective landing so that the at least one bump bond is aligned with the at least one signal

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output contact of the sensor. Support in the specification may be found in paragraphs 16 and 17, for example. The housing is then positioned in contact with the mounting substrate so that the housing and the sensor are in alignment.

The at least one landing and bump bond are provided as spots at specific locations. This specific arrangement of spot lands and bump bonds provides an advantageous effect of improving the alignment of the image sensor with the mounting substrate. There is a net effect of this action to draw the image sensor into a precise alignment with the aperture.

Independent Claim 57 has been amended similar to amended independent Claim 39, but does not recite the housing.

II. The Claims Are Patentable

The Examiner rejected independent Claims 39 and 57 over the Venkat et al. patent in view of the Bauer et al. patent. The Venkat et al. patent discloses an integrated lens and aperture plate for an optical sensor equipped integrated chip in which the lens and the aperture plate are molded as one piece with the lens at the appropriate location so that the lens aligns with the location of the optical sensor. In particular, FIG. 2 in the Venkat et al. patent illustrates a sensor **32** being attached to a mounting substrate **36**. The sensor **32** is attached via the pins extending therefrom by inserting the pins through the openings in the mounting substrate **36**.

As correctly noted by the Examiner, Venkat et al. fails to disclose the use of bump bonding for attaching the sensor to

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the mounting substrate. The Examiner cited the Bauer et al. patent, and in particular FIG. 2 therein, as disclosing the use of bump bonding using solder bump **120** in attaching an optical sensor **22** to a mounting base substrate **28** that comprises circuitry (e.g., conductive strip **30**).

The Examiner has taken the position that the use of bump bonding in the assembly of integrated circuit and printed circuit board devices is well known in the art, thus making it obvious to a person of ordinary skill in the art to use bump bonding in the assembly of the claimed invention.

The Applicants respectfully disagree. While bump bonding is more commonplace today, the bump bonds in Bauer et al. are attached to a long conductive strip **30** which extends from near the aperture **122** outwards to the edge of the base substrate **28**, as shown in FIG. 8. The same conductive strip is used in all embodiments.

It is also clear from FIG. 1 in Bauer et al. that the conductive strip is relatively wide. Bauer is silent regarding the issue of alignment. In many of the embodiments, conventional wire contacts **32** are used for aligning the optical sensor **22** with the substrate **28**.

In Venkat et al. conventional wire contacts are used for aligning the optical sensor IC **32** with the substrate. Venkat et al. teaches an IC which includes wire contacts for engagement with a series of apertures (no reference numeral) on the face of the PCB **36**, as indicated for example by the dotted lines in the diagrams.

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One skilled in the art would infer upon reading this document that the wire bonds, together with their corresponding apertures, would be necessary for ensuring an accurate alignment of the IC with the PCB. Venkat et al. is concerned with alignment of the sensor and the lens, and the approach taught is to integrate the lens with an aperture plate which also receives the IC **32**. The whole sensor/aperture plate/lens is attached to one side of the substrate. Therefore, Venkat et al. is not concerned with the precise alignment of the sensor and substrate. Also, the Venkat et al. requires additional components (aperture plate) and additional assembly steps.

In sharp contrast, independent Claim 39 has been amended to recite that the at least one bump bond is associated with a respective landing so that the at least one bump bond is aligned with the at least one signal output contact of the sensor. The at least one landing and bump bond are provided as spots at specific locations.

This specific arrangement of spot lands and bump bonds may provide an advantageous effect of improving the alignment of the image sensor with the mounting substrate. The bump bonds may be heated to melt the solder to make an electrical connection between the signal output contacts of the image sensor **14** and the PCB lands **18**, as shown in FIG. 1 associated with the Applicants' specification. As the spot bump bonds melt they try to minimize forces in their surface tension and thus deform evenly. There is thus a net effect of this action to draw the image sensor into a precise alignment with the aperture.

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The bump bonds and landings, thus provide an advantageous effect of actually improving the alignment of the sensor with the mounting substrate. This is not intuitively the case, as movement caused by the melting of the bump bonds would have normally been considered by one skilled in the art at the time of the invention to introduce a further inaccuracy or source of error in the alignment.

However, the Applicants have found that counter to these expectations, the bump bonds actually help with the alignment. A further advantage over the arrangement shown in the Venkat et al. patent is that extra holes do not need to be formed or drilled into the mounting substrate.

In addition, FIG. 2 of the Venkat et al. patent fails to illustrate positioning of a housing in contact with the mounting substrate so that the housing and the sensor are in alignment, as recited in amended independent Claim 39. Instead, Venkat et al. is directed to integration of the sensor with the integrated circuit before its attachment to the substrate.

Accordingly, it is submitted that amended independent Claim 39 is patentable over the Venkat et al. patent. Amended independent Claim 57 is similar to amended independent Claim 39. Therefore, it is submitted that this claim is also patentable over the Venkat et al. patent.

In view of the patentability of amended independent Claims 39 and 57, it is submitted that the dependent claims, which include yet further distinguishing features of the invention are also patentable. These dependent claims need no

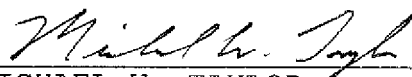
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further discussion herein.

IV. CONCLUSION

In view of the amendments to the claims and the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,



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